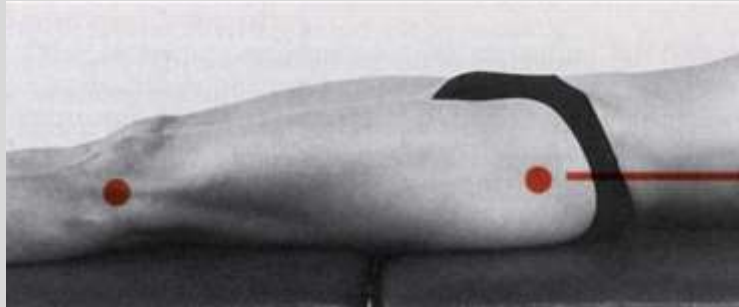


Goniometer measurement for lower limb

Hip Flexion:-

Fig. 11-5. Starting position for measurement of hip flexion. Bony landmarks for goniometer alignment (lateral midline of pelvis/trunk, greater trochanter, lateral femoral epicondyle) indicated by orange line and dots.



Patient position:

Supine, with lower extremities in anatomical position (Fig. 11-5).

Stabilization:

Over anterior aspect of ipsilateral pelvis (Fig. 11-6).

Examiner action:

After instructing patient in motion desired, stabilize ipsilateral pelvis with one hand and flex patient's hip through available ROM with other hand. Ipsilateral knee should be allowed to flex as well. Hip should not be flexed past the point at which pelvic motion begins to occur (as detected by superior movement of ipsilateral ASIS under examiner's stabilizing hand). Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 11-6).

Goniometer alignment:

Palpate following bony landmarks (shown in Fig. 11-5) and align goniometer accordingly (Fig. 11-7).

Stationary arm:

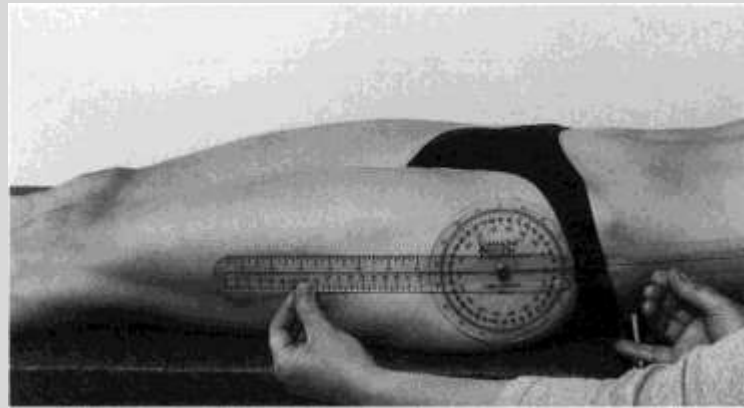
Lateral midline of pelvis and trunk.

* Lateral midline of pelvis should parallel midline of trunk as long as pelvic motion is prevented and neutral pelvis is maintained (see description of neutral pelvis in Techniques of Measurement: Hip Flexion/Extension).

Fig. 11-6. End of hip flexion ROM, showing proper hand placement for stabilizing pelvis and detecting pelvic motion. Bony landmarks for goniometer alignment (lateral midline of pelvis/trunk, greater trochanter, lateral femoral epicondyle) indicated by orange line and dots.



Fig. 11-7. Starting position for measurement of hip flexion, demonstrating proper initial alignment of goniometer.



Axis: Greater trochanter of femur.

Moving arm: Lateral midline of femur toward lateral femoral epicondyle.

Read scale of goniometer.

Patient/Examiner action: Perform passive, or have patient perform active, hip flexion (Fig. 11-8). In either case, hip flexion should not be allowed to continue past point at which pelvic motion is detected (see Examiner action).

Confirmation of alignment: Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary (see Fig. 11-8). Read scale of goniometer.

Documentation: Record patient's ROM.

Precaution: Should hip be allowed to flex past point at which pelvic motion begins to occur, motion measured will include both hip and lumbar flexion. In order to isolate hip flexion, pelvic motion must not be permitted.

Alternative patient position: Sidelying. Stabilization of pelvis more difficult with patient in this position. Goniometer alignment remains the same.

Fig. 11-8. End of hip flexion ROM, demonstrating proper alignment of goniometer at end of range.



Hip Extension:-



Fig. 11-9. Starting position for measurement of hip extension. Bony landmarks for goniometer alignment (lateral midline of pelvis/trunk, greater trochanter, lateral femoral epicondyle) indicated by orange line and dots.

Patient position:	Prone, with lower extremities in anatomical position (Fig. 11-9).
Stabilization:	Over posterolateral aspect of ipsilateral pelvis with palm of hand, while fingers palpate ASIS (Fig. 11-10).
Examiner action:	After instructing patient in motion desired, stabilize ipsilateral pelvis with one hand and extend patient's hip through available ROM with other hand. Ipsilateral knee should be kept extended to avoid limitation of hip extension by tight rectus femoris muscle. Hip should not be extended past the point at which pelvic motion begins to occur (as detected by inferior movement of ipsilateral ASIS under examiner's stabilizing hand). Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 11-10).
Goniometer alignment:	Palpate following bony landmarks (shown in Fig. 11-9) and align goniometer accordingly (Fig. 11-11).
Stationary arm:	Lateral midline of pelvis and trunk.*

* Lateral midline of pelvis should parallel midline of trunk as long as pelvic motion is prevented and neutral pelvis is maintained (see description of neutral pelvis in Techniques of Measurement: Hip Flexion/Extension).

Fig. 11-10. End of hip extension ROM, showing proper hand placement for stabilizing pelvis and detecting pelvic motion. Bony landmarks for goniometer alignment (lateral midline of pelvis/trunk, greater trochanter, lateral femoral epicondyle) indicated by orange line and dots.

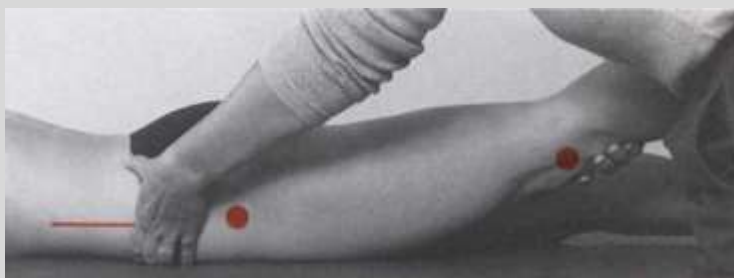
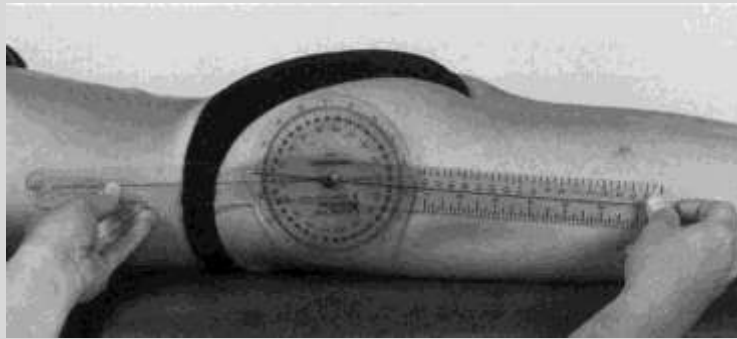


Fig. 11-11. Starting position for measurement of hip extension, demonstrating proper initial alignment of goniometer.



Axis: Greater trochanter of femur.

Moving arm: Lateral midline of femur toward lateral femoral epicondyle.

Read scale of goniometer.

Patient/Examiner action: Perform passive, or have patient perform active, hip extension (Fig. 11-12). In either case, hip extension should not be allowed to continue past point at which pelvic motion is detected (see Examiner action).

Confirmation of alignment: Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary (see Fig. 11-12). Read scale of goniometer.

Documentation: Record patient's ROM.

Precaution: Should hip be allowed to extend past point at which pelvic motion begins to occur, motion measured will include both hip and lumbar extension. In order to isolate hip extension, pelvic motion must not be permitted.

Alternative patient position: Sidelying. Stabilization of pelvis more difficult with patient in this position. Goniometer alignment remains the same.

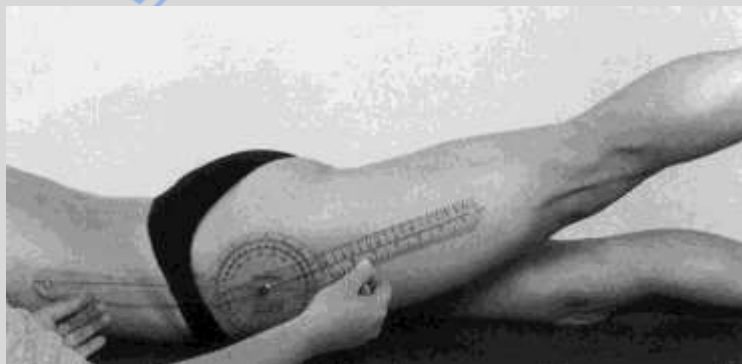


Fig. 11-12. End of hip extension ROM, demonstrating proper alignment of goniometer at end of range.

Hip Abduction:-

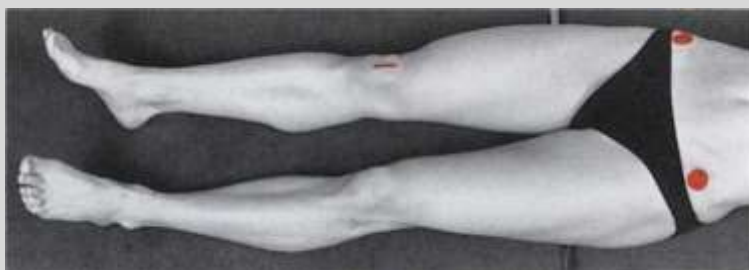


Fig. 11-13. Starting position for measurement of hip abduction. Bony landmarks for goniometer alignment (ipsilateral ASIS, contralateral ASIS, midline of patella) indicated by orange dots and line.

Patient position:	Supine, with lower extremities in anatomical position (Fig. 11-13).
Stabilization:	Over anterior aspect of ipsilateral pelvis (Fig. 11-14).
Examiner action:	After instructing patient in motion desired, abduct patient's hip through available ROM, avoiding hip rotation. Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 11-14).
Goniometer alignment:	Palpate following bony landmarks (shown in Fig. 11-13) and align goniometer accordingly (Fig. 11-15).
Stationary arm:	Toward contralateral ASIS.
Axis:	Ipsilateral ASIS.

Fig. 11-14. End of hip abduction ROM, showing proper hand placement for stabilizing pelvis. Bony landmarks for goniometer alignment (ipsilateral ASIS, contralateral ASIS, midline of patella) indicated by orange dots and line.

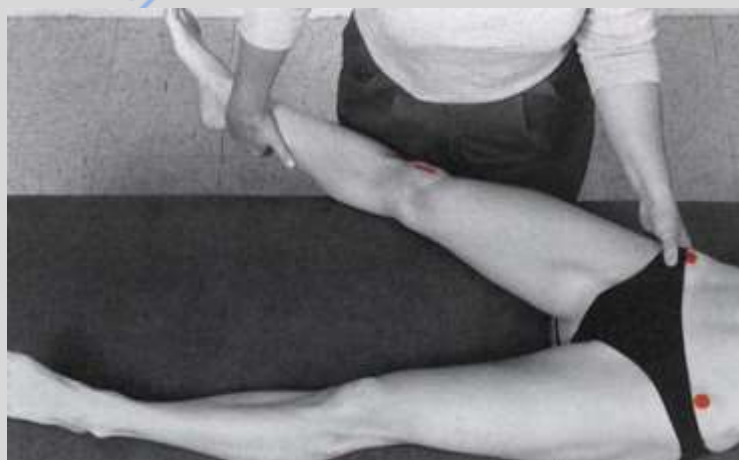
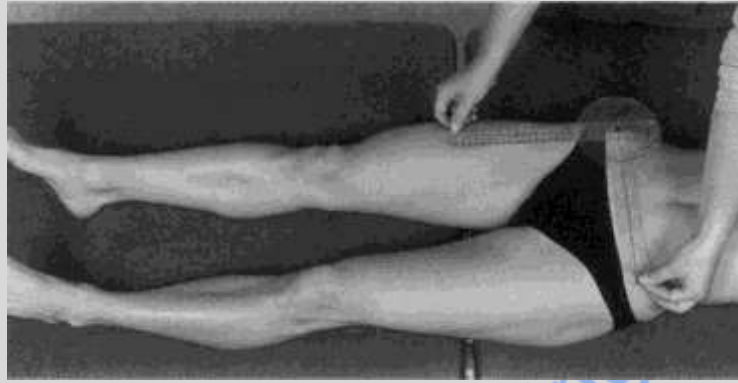


Fig. 11-15. Starting position for measurement of hip abduction, demonstrating proper initial alignment of goniometer.



Moving arm:

Anterior midline of ipsilateral femur, using midline of patella as reference.

Read scale of goniometer.

Patient/Examiner action:

Perform passive, or have patient perform active, hip abduction (Fig. 11-16).

Confirmation of alignment:

Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary (see Fig. 11-16) (see Note). Read scale of goniometer.

Documentation:

Record patient's ROM.

Note:

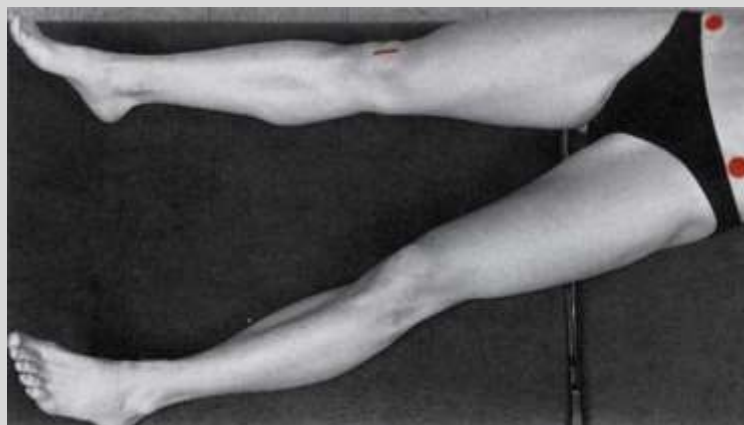
Confirmation of alignment of stationary arm is critical to avoid including lateral pelvic tilting in hip abduction ROM.



Fig. 11-16. End of hip abduction ROM, demonstrating proper alignment of goniometer at end of range.

Hip Adduction:-

Fig. 11-17. Starting position for measurement of hip adduction. Contralateral hip is abducted to allow room for adduction of ipsilateral hip. Bony landmarks for goniometer alignment (ipsilateral ASIS, contralateral ASIS, midline of patella) indicated by orange dots and line.



Patient position:

Supine with ipsilateral lower extremity in anatomical position; contralateral hip abducted (Fig. 11-17).

Stabilization:

Over anterior aspect of ipsilateral pelvis (Fig. 11-18).

Examiner action:

After instructing patient in motion desired, adduct patient's hip through available ROM, avoiding hip rotation. Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 11-18).

Goniometer alignment:

Palpate following bony landmarks (shown in Fig. 11-17) and align goniometer accordingly (Fig. 11-19).

Stationary arm:

Toward contralateral ASIS.

Axis:

Ipsilateral ASIS.

Fig. 11-18. End of hip adduction ROM, showing proper hand placement for stabilizing pelvis. Bony landmarks for goniometer alignment (ipsilateral ASIS, contralateral ASIS, midline of patella) indicated by orange dots and line.



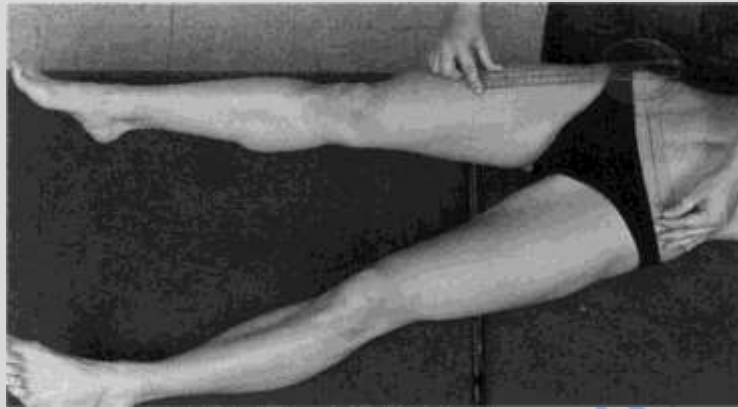


Fig. 11-19. Starting position for measurement of hip adduction, demonstrating proper initial alignment of goniometer.

Moving arm: Anterior midline of femur, using midline of patella as reference.
Read scale of goniometer.

Patient/Examiner action: Perform passive, or have patient perform active, hip adduction (Fig. 11-20).

Confirmation of alignment: Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary (see Fig. 11-20) (see Note). Read scale of goniometer.

Documentation: Record patient's ROM.

Note: Confirmation of alignment of stationary arm is critical to avoid including lateral pelvic tilting in hip adduction ROM.



Fig. 11-20. End of hip adduction ROM, demonstrating proper alignment of goniometer at end of range.

Hip Lateral Rotation:-

Fig. 11-21. Starting position for measurement of hip lateral rotation. Weight is distributed evenly over both ischial tuberosities. Towel roll is placed under ipsilateral thigh to position femur in horizontal plane. Bony landmarks for goniometer alignment (midpoint of patella, tibial crest) indicated by orange dot and line.



Patient position:

Seated, with hip and knee flexed to 90 degrees, folded towel under thigh; weight equally distributed over both ischial tuberosities (Fig. 11-21).

Stabilization:

None needed; pelvis is stabilized by patient's weight.

Examiner action:

After instructing patient in motion desired, laterally rotate patient's hip through available ROM by keeping the thigh stationary and moving the leg, foot, and ankle medially. Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (Fig. 11-22).

Goniometer alignment:

Palpate following bony landmarks (shown in Fig. 11-21) and align the goniometer accordingly (Fig. 11-23).

Stationary arm:

Perpendicular to floor.

Axis:

Midpoint of patella.

Moving arm:

Anterior midline of tibia, along tibial crest.

Read scale of goniometer.

Fig. 11-22. End of hip lateral rotation ROM. Examiner's hand stabilizes thigh against table. Bony landmarks for goniometer alignment (midpoint of patella, tibial crest) indicated by orange dot and line.



Fig. 11-23. Starting position for measurement of hip lateral rotation, demonstrating proper initial alignment of goniometer.



Patient/Examiner action:

Perform passive, or have patient perform active, hip lateral rotation. Patient should be instructed to maintain equal weight on both ischial tuberosities (Fig. 11-24).

Confirmation of alignment:

Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary (see Fig. 11-24). Read scale of goniometer.

Documentation:

Record patient's ROM.

Precaution:

Do not allow patient to laterally flex trunk to ipsilateral side or lift ipsilateral thigh from table during measurement, as doing so will result in a falsely increased ROM.

Alternative position:

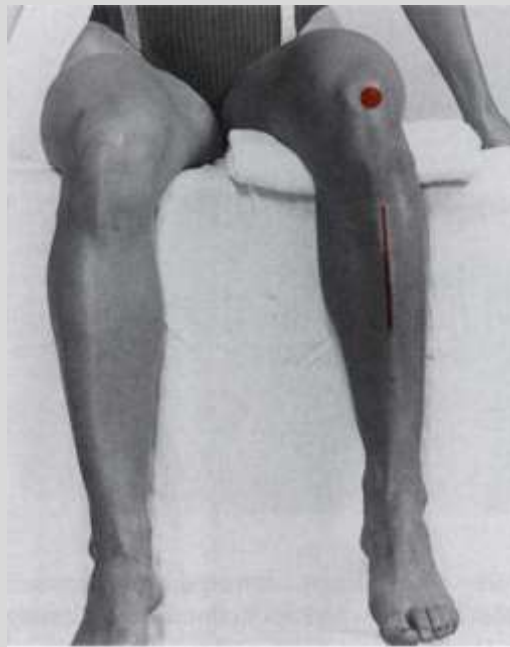
Supine with hip and knee flexed 90 degrees. Stationary arm of goniometer is aligned parallel to anterior midline of trunk. Alignment of rest of goniometer remains the same.

Fig. 11-24. End of hip lateral rotation ROM, demonstrating proper alignment of goniometer at end of range.



Hip Medial Rotation:-

Fig. 11-25. Starting position for measurement of hip medial rotation. Weight is distributed evenly over both ischial tuberosities. Towel roll is placed under ipsilateral thigh to position femur in horizontal plane. Bony landmarks for goniometer alignment (midpoint of patella, tibial crest) indicated by orange dot and line.



Patient position:

Seated, with hip and knee flexed to 90 degrees, folded towel under thigh; weight equally distributed over both ischial tuberosities (Fig. 11-25).

Stabilization:

None needed; pelvis is stabilized by patient's weight.

Examiner action:

After instructing patient in motion desired, medially rotate patient's hip through available ROM by keeping the thigh stationary and moving the leg, foot, and ankle laterally. Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (Fig. 11-26).

Goniometer alignment:

Palpate following bony landmarks (shown in Fig. 11-25) and align goniometer accordingly (Fig. 11-27).

Stationary arm:

Perpendicular to floor.

Axis:

Midpoint of patella.

Fig. 11-26. End of hip medial rotation ROM. Examiner's hand stabilizes thigh against table. Bony landmarks for goniometer alignment (midpoint of patella, tibial crest) indicated by orange dot and line.



Fig. 11-27. Starting position for measurement of hip medial rotation, demonstrating proper initial alignment of goniometer.



Moving arm: Anterior midline of tibia, along tibial crest.

Read scale of goniometer.

Patient/Examiner action: Perform passive, or have patient perform active, hip medial rotation. Patient should be instructed to maintain equal weight on both ischial tuberosities (Fig. 11-28).

Confirmation of alignment: Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary (see Fig. 11-28). Read scale of goniometer.

Documentation: Record patient's ROM.

Precaution: Do not allow patient to laterally flex trunk to contralateral side or lift ipsilateral thigh from table during measurement, as doing so will result in a falsely increased ROM.

Alternative patient position: Supine with hip and knee flexed to 90 degrees. Stationary arm of goniometer is aligned parallel to anterior midline of trunk. Alignment of rest of goniometer remains the same.



Fig. 11-28. End of hip medial rotation ROM, demonstrating proper alignment of goniometer at end of ROM.

Knee Flexion:-

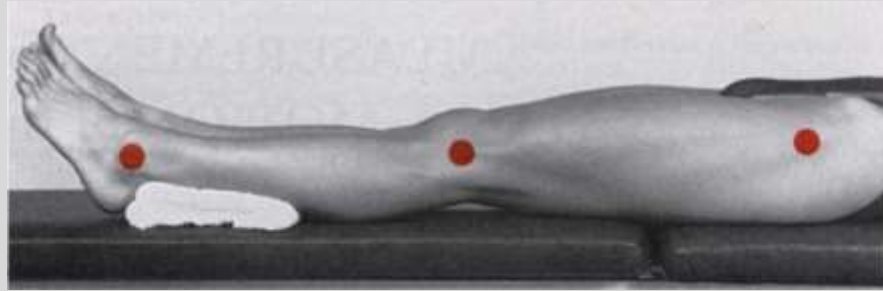


Fig. 12-1 . Starting position for measurement of knee flexion. Towel roll under ipsilateral ankle to promote full knee extension. Bony landmarks for goniometer alignment (greater trochanter, lateral femoral epicondyle, lateral malleolus) indicated by orange dots.

Patient position:

Supine, with lower extremities in anatomical position; towel roll under ipsilateral ankle (Fig. 12-1).

Stabilization:

Over anterior aspect of thigh (Fig. 12-2).

Examiner action:

After instructing patient in motion desired, flex patient's knee through available ROM by sliding patient's foot along table toward pelvis. Return to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient the exact motion desired (see Fig. 12-2).

Fig. 12-2. End of knee flexion ROM, showing proper hand placement for stabilization of ipsilateral thigh. Bony landmarks for goniometer alignment (greater trochanter, lateral femoral epicondyle, lateral malleolus) indicated by orange dots.

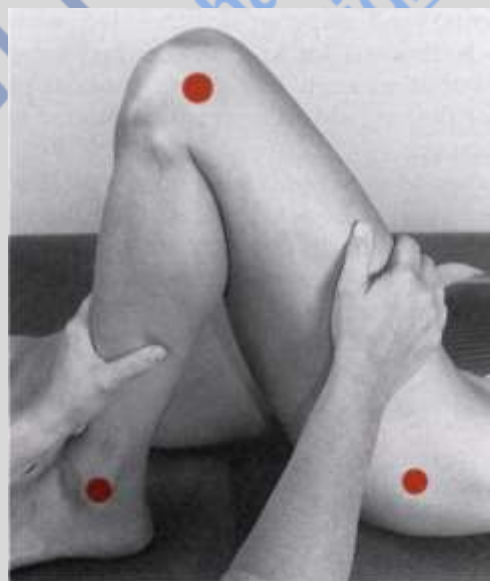
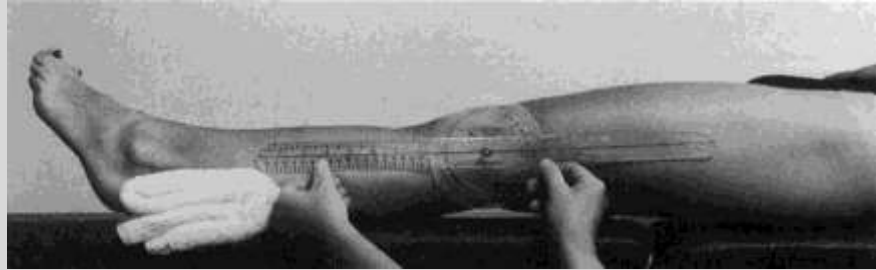


Fig. 12-3. Starting position for measurement of knee flexion demonstrating proper initial alignment of goniometer.



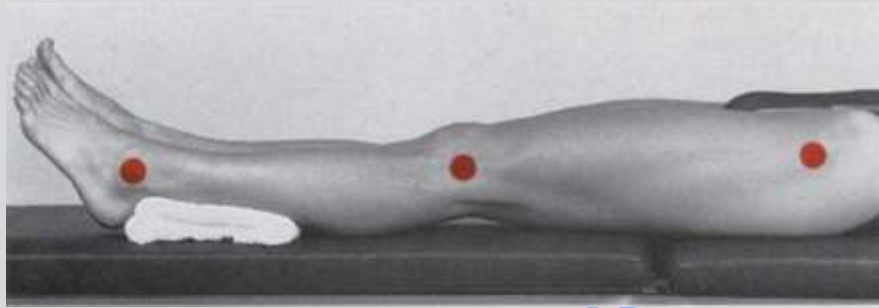
Goniometer alignment:	Palpate following bony landmarks (shown in Fig. 12-1) and align goniometer accordingly (Fig. 12-3).
Stationary arm:	Lateral midline of femur toward greater trochanter.
Axis:	Lateral epicondyle of femur.
Moving arm:	Lateral midline of fibula, in line with fibular head and lateral malleolus. Read scale of goniometer.
Patient/Examiner action:	Perform passive, or have patient perform active, knee flexion by sliding foot toward pelvis (Fig. 12-4).
Confirmation of alignment:	Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary (see Fig. 12-4). Read scale of goniometer.
Documentation:	Record patient's ROM.
Note:	Knee flexion may be measured with patient in prone position, but knee flexion ROM in prone may be limited owing to tightness of rectus femoris muscle.
Alternative patient position:	Prone (see preceding Note) or sidelying. In either case, goniometer alignment remains the same.

Fig. 12-4. End of knee flexion ROM, demonstrating proper alignment of goniometer at end of range.



Knee Extension:-

Fig. 12-5. Starting position for measurement of knee extension. Towel roll under ipsilateral ankle to promote full knee extension. Bony landmarks for goniometer alignment (greater trochanter, lateral femoral epicondyle, lateral malleolus) indicated by orange dots.



Patient position:

Supine, with knee extended as far as possible; towel roll under ipsilateral ankle (Fig. 12-5).

Stabilization:

None needed.

Examiner action:

Determine whether knee is extended as far as possible by either: a) asking patient to straighten knee as far as possible (if measuring active ROM), or b) providing passive pressure on the knee in the direction of extension (if measuring passive ROM) (Fig. 12-6).

Fig. 12-6. End of knee extension ROM. Examiner is ensuring complete knee extension through posteriorly directed pressure on the distal thigh. Bony landmarks for goniometer alignment (greater trochanter, lateral femoral epicondyle, lateral malleolus) indicated by orange dots.



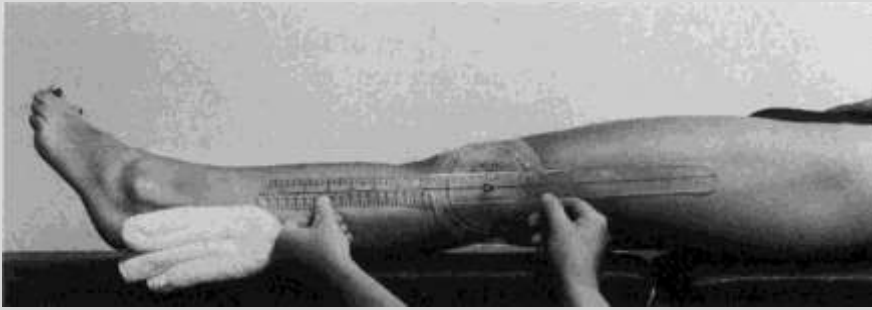


Fig. 12-7. Measurement of knee extension demonstrating proper alignment of goniometer.

Goniometer alignment: Palpate the following bony landmarks (shown in Fig. 12-5) and align goniometer accordingly (Fig. 12-7).

Stationary arm: Lateral midline of femur toward greater trochanter.

Axis: Lateral epicondyle of femur.

Moving arm: Lateral midline of fibula, in line with fibular head and lateral malleolus.

Read scale of goniometer.

Documentation: Record patient's ROM.

Alternative patient position: Prone or sidelying. If prone position is used, it may be necessary to place a towel roll under the anterior aspect of the patient's thigh, and the patient's foot must be off the table in order to obtain full knee extension. With either position, goniometer alignment remains the same.

Ankle Supination: Plantarflexion Component



Fig. 13-1. Starting position for measurement of ankle supination: Plantarflexion component. Bony landmarks for goniometer alignment (fibular head, lateral malleolus, lateral midline of 5th metatarsal) indicated by orange line and dots.

Patient position: Supine or sitting (see Note), with knee flexed (as shown) or extended, ankle in anatomical position (Fig. 13-1).

Stabilization: Over posterior aspect of distal leg (Fig. 13-2).

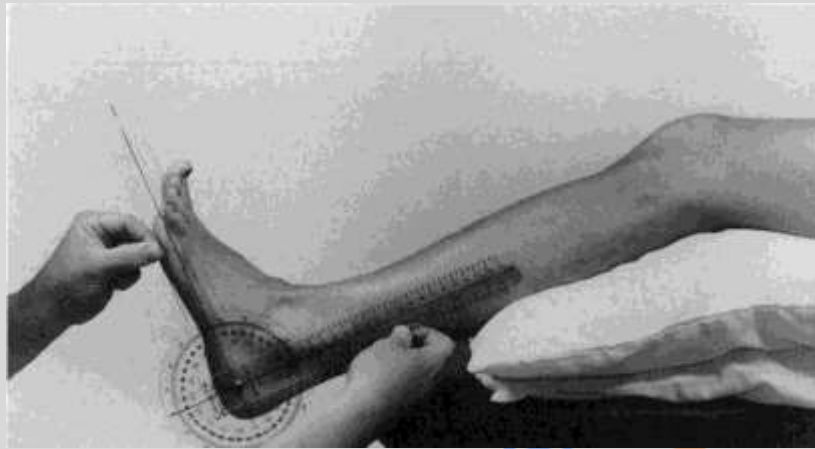
Examiner action: After instructing patient in motion desired, plantarflex patient's ankle through available ROM. Return to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-2).

Goniometer alignment: Palpate following bony landmarks (shown in Fig. 13-1) and align goniometer accordingly (Fig. 13-3).



Fig. 13-2. End of ankle supination: plantarflexion component ROM, showing proper hand placement for stabilizing leg. Bony landmarks for goniometer alignment (fibular head, lateral malleolus, lateral midline of 5th metatarsal) indicated by orange line and dots.

Fig. 13-3. Starting position for measurement of ankle supination: Plantarflexion component, demonstrating proper initial alignment of goniometer. Note that axis of goniometer is positioned at the intersection point of lines through the lateral midline of the fibula and the 5th metatarsal.



Stationary arm:

Lateral midline of fibula, in line with fibular head.

Axis:

Distal to, but in line with lateral malleolus, at intersection of lines through lateral midline of fibula and lateral midline of 5th metatarsal.

Moving arm:

Lateral midline of 5th metatarsal.

Read scale of goniometer.

Patient/Examiner action:

Perform passive, or have patient perform active, ankle plantarflexion (Fig. 13-4).

Confirmation of alignment:

Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-4).

Documentation:

Record patient's ROM.

Note:

Supine position is preferred over sitting position for measurements of ankle motion, as bony landmarks are placed more easily at the examiner's eye level when the patient is supine.

Alternative patient position:

Prone or sidelying. In either case, goniometer alignment remains the same.

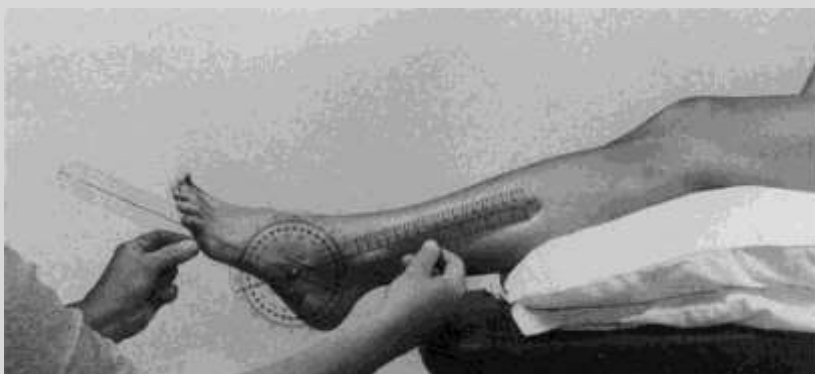
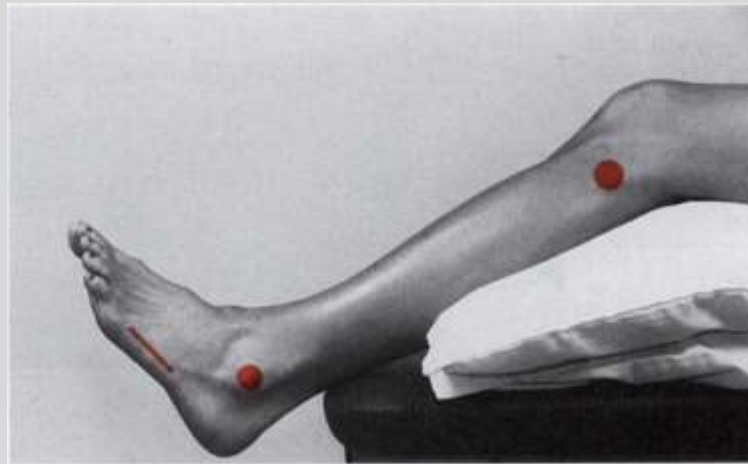


Fig. 13-4. End of ankle supination: plantarflexion component ROM, demonstrating proper alignment of goniometer at end of range.

Ankle pronation: Dorsiflexion

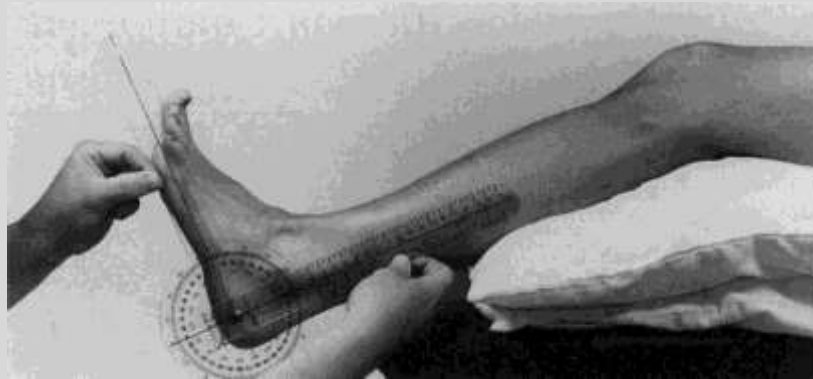


- Patient position:** Supine or sitting (see Note), with knee flexed at least 30 degrees, ankle in anatomical position (Fig. 13-5).
- Stabilization:** Over anterior aspect of distal leg (Fig. 13-6).
- Examiner action:** After instructing patient in motion desired, dorsiflex patient's ankle through available ROM. Return to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-6).
- Goniometer alignment:** Palpate following bony landmarks (shown in Fig. 13-5) and align goniometer accordingly (Fig. 13-7).



Fig. 13-6. End of ankle pronation: dorsiflexion component ROM, showing proper hand placement for stabilizing leg and dorsiflexing joint. Note that motion is achieved through upward pressure on the plantar surfaces of metatarsals 4 and 5. Bony landmarks for goniometer alignment (fibular head, lateral malleolus, lateral midline of 5th metatarsal) indicated by orange line and dots.

Fig. 13-7. Starting position for measurement of ankle pronation: dorsiflexion component, demonstrating proper initial alignment of goniometer. Note that axis of goniometer is positioned at the intersection point of lines through the lateral midline of the fibula and the 5th metatarsal.



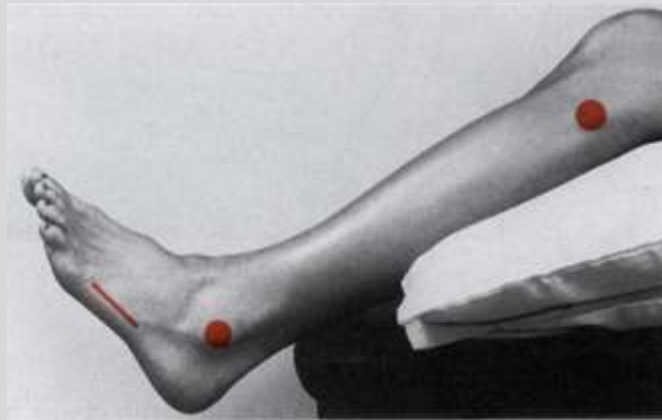
Stationary arm:	Lateral midline of fibula, in line with fibular head.
Axis:	Distal to, but in line with lateral malleolus, at intersection of lines through lateral midline of fibula and lateral midline of 5th metatarsal.
Moving arm:	Lateral midline of 5th metatarsal.
	Read scale of goniometer.
Patient/Examiner action:	Perform passive, or have patient perform active, ankle dorsiflexion (Fig. 13-8).
Confirmation of alignment:	Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-8).
Documentation:	Record patient's ROM.
Note:	Supine position is preferred over sitting position for measurements of ankle motion, as bony landmarks are placed more easily at the examiner's eye level when the patient is supine.
Alternative patient position:	Prone or sidelying. In either case, goniometer alignment remains the same. Motion also can be measured with knee extended, providing an estimation of gastrocnemius tightness (see Figs. 14-32 through 14-34).

Fig. 13-8. End of ankle pronation: dorsiflexion component ROM, demonstrating proper alignment of goniometer at end of range.



Ankle Pronation: Dorsiflexion Component in Subtalar Neutral Position

Fig. 13-9. Starting position for measurement of ankle pronation: dorsiflexion component, with subtalar joint in neutral position. Bony landmarks for goniometer alignment (fibular head, lateral malleolus, lateral midline of 5th metatarsal) indicated by orange line and dots.



An assistant is needed to perform this measurement correctly.

Patient position:

Supine or sitting, with knee flexed at least 30 degrees, ankle in anatomical position (Fig. 13-9).

Stabilization:

Over head of talus (see Examiner action).

Examiner action (Examiner #1):

1. Place patient's subtalar joint in neutral position as follows:
 - a. Grasp medial and lateral sides of talar head with thumb and index finger of one hand.
 - b. With other hand, passively pronate and supinate foot until talar head is felt equally against both thumb and index finger. This position is subtalar neutral.



Fig. 13-10. End of ankle pronation: dorsiflexion component ROM, with subtalar joint maintained in neutral position. The examiner's left hand is grasping the talar head to ensure the maintenance of a neutral subtalar joint position, while the right hand is dorsiflexing the ankle through upward pressure on the plantar surfaces of metatarsals 4 and 5. Bony landmarks for goniometer alignment (fibular head, lateral malleolus, lateral midline of 5th metatarsal) indicated by orange line and dots.



Fig. 13-11. Starting position for measurement of ankle pronation: dorsiflexion component, with subtalar joint maintained in neutral position, demonstrating proper initial alignment of goniometer. Examiner #1 maintains the subtalar joint in a neutral position by grasping the talar head, while examiner #2 aligns the goniometer. Note that axis of goniometer is positioned at the intersection point of lines through the lateral midline of the fibula and the 5th metatarsal.

2. Passively dorsiflex patient's ankle through available ROM with one hand, while maintaining grasp on talus with opposite hand, assuring that subtalar neutral position is maintained during entire range of dorsiflexion (Fig. 13-10). Return to starting position.

**Goniometer alignment
(Examiner #2):**

Examiner #2 aligns goniometer as described for ankle dorsiflexion test (landmarks shown in Fig. 13-9) and reads scale of goniometer (Fig. 13-11).

Patient/Examiner action:

Examiner #1 performs passive, or has patient perform active, ankle dorsiflexion while maintaining subtalar joint in neutral position (Fig. 13-12).

**Confirmation of
alignment:**

Examiner #2 repalpates landmarks and confirms proper alignment at end of ROM, correcting alignment as necessary. Examiner #2 reads scale of goniometer (Fig. 13-12).

Documentation:

Record patient's ROM.

Precaution:

Reliability of this measurement technique may be poor owing to questionable reliability of establishing neutral position of subtalar joint.

Fig. 13-12. End of ankle pronation: dorsiflexion component ROM, with subtalar joint maintained in neutral position, demonstrating proper alignment of goniometer at end of range. Examiner #1 maintains subtalar joint in neutral position while passively dorsiflexing the ankle. Examiner #2 performs goniometric measurement of motion.



Ankle/foot pronation: Inversion component



Patient position: Seated, with ankle in anatomical position (Fig. 13-13).

Stabilization: Over posterior aspect of distal leg (Fig. 13-14).

Examiner action: After instructing patient in motion desired, invert patient's foot/ankle through available ROM. Return to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-14).

Goniometer alignment: Palpate following bony landmarks (shown in Fig. 13-13) and align goniometer accordingly (Fig. 13-15).

Stationary arm: Anterior midline of tibia, in line with tibial crest.

Fig. 13-14. End of combined ankle/foot supination: inversion component ROM, showing proper hand placement for stabilizing tibia and inverting ankle/foot. Bony landmarks for goniometer alignment (tibial crest, anterior midline of talocrural joint, anterior midline of 2nd metatarsal) indicated by orange lines and dot.



Fig. 13-15. Starting position for measurement of ankle/foot supination: inversion component, demonstrating proper initial alignment of goniometer.



Axis:

Anterior aspect of talocrural joint, midway between medial and lateral malleoli.

Moving arm:

Anterior midline of 2nd metatarsal.

Read scale of goniometer.

Perform passive, or have patient perform active, ankle/foot inversion (Fig. 13-16).

Patient/Examiner action:

Confirmation of alignment:

Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-16).

Documentation:

Record patient's ROM.

Alternative patient position:

Supine, with ankle in anatomical position; goniometer alignment remains the same.

Fig. 13-16. End of ankle/foot supination: inversion component ROM, demonstrating proper alignment of goniometer at end of range.



Ankle/foot pronation: Eversion component



Patient position:

Seated, with ankle in anatomical position (Fig. 13-17).

Stabilization:

Over posterior aspect of distal leg (Fig. 13-18).

Examiner action:

After instructing patient in motion desired, evert patient's foot/ankle through available ROM. Return to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-18).

Goniometer alignment:

Palpate following bony landmarks (shown in Fig. 13-17) and align goniometer accordingly (Fig. 13-19).

Stationary arm:

Anterior midline of tibia, in line with tibial crest.

Axis:

Anterior aspect of talocrural joint, midway between medial and lateral malleoli.

Fig. 13-18. End of combined ankle/foot pronation: eversion component ROM, showing proper hand placement for stabilizing tibia and inverting ankle/foot. Bony landmarks for goniometer alignment (tibial crest, anterior midline of talocrural joint, anterior midline of 2nd metatarsal) indicated by orange lines and dot.



Fig. 13-19. Starting position for measurement of ankle/foot pronation: eversion component, demonstrating proper initial alignment of goniometer.



Moving arm:

Anterior midline of 2nd metatarsal.

Read scale of goniometer.

Patient/Examiner action:

Perform passive, or have patient perform active, ankle /foot eversion (Fig. 13-20).

Confirmation of alignment:

Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-20).

Documentation:

Record patient's ROM.

Alternative patient position:

Supine, with ankle in anatomical position; goniometer alignment remains the same.

Fig. 13-20. End of ankle/foot pronation: eversion component ROM, demonstrating proper alignment of goniometer at end of range.



Subtalar Supination: Inversion Component **(Referenced from Anatomical Zero)**

Fig. 13-21. Starting position for measurement of subtalar supination: inversion component, referenced from anatomical zero. Position of contralateral lower extremity places ipsilateral calcaneus in the frontal plane. Calipers are used to determine posterior midline of leg and calcaneus (see text for instructions). Landmarks for goniometer alignment (posterior midline of leg, calcaneal tendon in line with malleoli, posterior midline of calcaneus) indicated by orange lines and dot.



Patient position:

Prone, with lower extremity to be measured in anatomical position; foot off end of table. Opposite lower extremity positioned in hip flexion, abduction, and external rotation with knee flexed (Fig. 13-21).

Stabilization:

Over distal aspect of ipsilateral leg (Fig. 13-22).

Examiner action:

After instructing patient in procedure to be performed, invert patient's calcaneus by moving it medially. Performing passive movement provides an estimate of the ROM and demonstrates procedure to patient (see Fig. 13-22).

Goniometer alignment:

Palpate following landmarks (shown in Fig. 13-21) and align goniometer accordingly (Fig. 13-23).

Fig. 13-22. End of subtalar supination: inversion component ROM, showing proper hand placement for stabilizing tibia and inverting subtalar joint. Landmarks for goniometer alignment (posterior midline of leg, calcaneal tendon in line with malleoli, posterior midline of calcaneus) indicated by orange lines and dot.

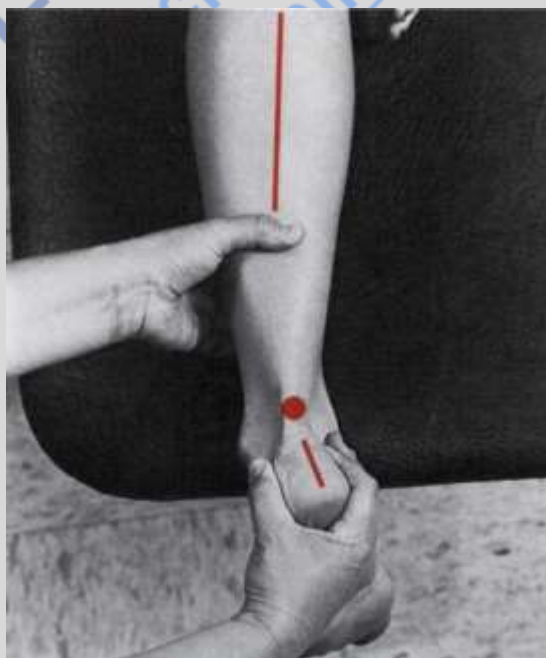
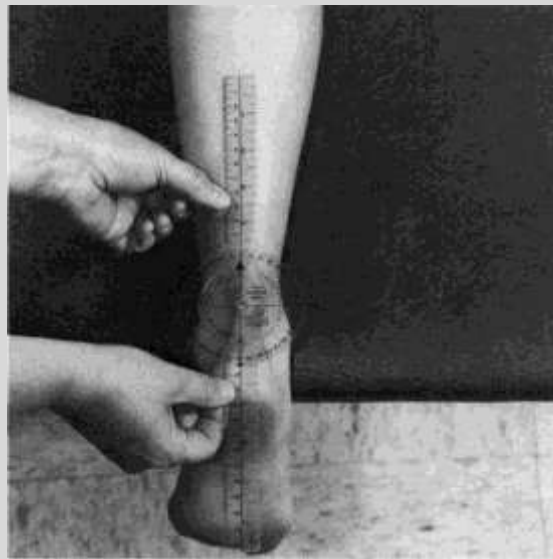


Fig. 13-23. Starting position for measurement of subtalar supination: inversion component, demonstrating proper alignment of goniometer. Calcaneus is positioned so that goniometer reads 0 degrees at beginning of ROM.



Stationary arm:

Posterior midline of leg (use of calipers* is recommended for determining this line; see Fig. 13-21).

Axis:

Over calcaneal tendon in line with malleoli.

Moving arm:

Posterior midline of calcaneus (use of calipers* is recommended for determining this line).

Move patient's calcaneus until scale of goniometer reads 0 degrees. This is the 0-degree starting position.

Examiner action:

Perform passive, or have patient perform active, calcaneal inversion (Fig. 13-24).

Confirmation of alignment:

Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-24).

Documentation:

Record patient's ROM.

* Caliper use: Calipers are placed near proximal end of structure (leg or calcaneus) with vertical arms contacting medial and lateral aspects of structure (without compressing tissue). Dot is made on structure at midpoint between vertical arms. Calipers are then moved to distal aspect of structure and above procedure repeated. Line connecting proximal and distal dots, which will accurately represent midline of structure, is drawn.

Fig. 13-24. End of subtalar supination: inversion component ROM, demonstrating proper alignment of goniometer at end of range.



Subtalar Pronation: Eversion Component **(Referenced from Anatomical Zero)**

Fig. 13-25. Starting position for measurement of subtalar pronation: eversion component, referenced from anatomical zero. Position of contralateral lower extremity places ipsilateral calcaneus in the frontal plane. Calipers are used to determine posterior midline of leg and calcaneus (see text for instructions). Landmarks for goniometer alignment (posterior midline of leg, calcaneal tendon in line with malleoli, posterior midline of calcaneus) indicated by orange lines and dot.



Patient position:

Prone, with lower extremity to be measured in anatomical position; foot off end of table. Opposite lower extremity position in hip flexion, abduction, and external rotation with knee flexed (Fig. 13-25).

Stabilization:

Over distal aspect of ipsilateral leg (Fig. 13-26).

Examiner action:

After instructing patient in procedure to be performed, evert patient's calcaneus by moving it laterally. Performing passive movement provides an estimate of the ROM and demonstrates procedure to patient (see Fig. 13-26).

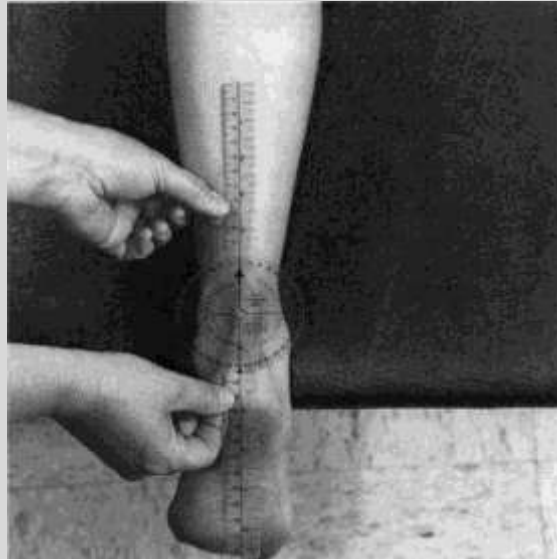
Goniometer alignment:

Palpate following landmarks (shown in Fig. 13-25) and align goniometer accordingly (Fig. 13-27).

Fig. 13-26. End of subtalar pronation: eversion component ROM, showing proper hand placement for stabilizing tibia and everting subtalar joint. Landmarks for goniometer alignment (posterior midline of leg, calcaneal tendon in line with malleoli, posterior midline of calcaneus) indicated by orange lines and dot.



Fig. 13-27. Starting position for measurement of subtalar pronation: eversion component, demonstrating proper alignment of goniometer. Calcaneus is positioned so that goniometer reads 0 degrees at beginning of ROM.



Stationary arm:

Posterior midline of leg (use of calipers* is recommended for determining this line; see Fig. 13-25).

Axis:

Over calcaneal tendon in line with malleoli.

Moving arm:

Posterior midline of calcaneus (use of calipers* is recommended for determining this line).

Move patient's calcaneus until scale of goniometer reads 0 degrees. This is the 0-degree starting position.

Examiner action:

Perform passive, or have patient perform active, calcaneal eversion (Fig. 13-28).

Confirmation of alignment:

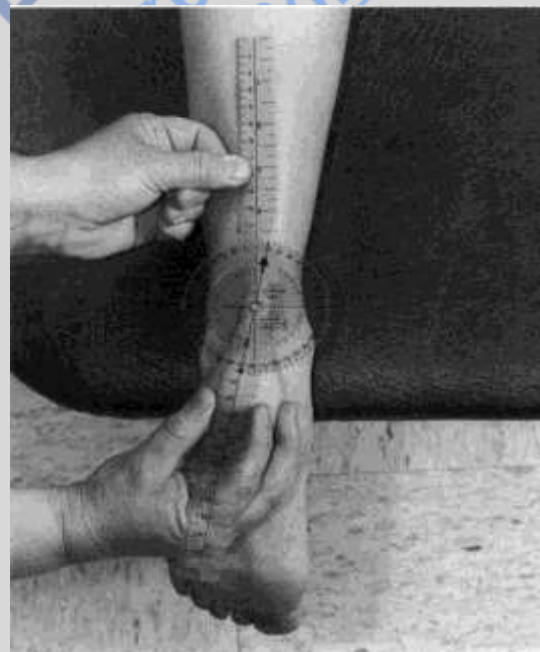
Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-28).

Documentation:

Record patient's ROM.

* Caliper use: See the footnote under Subtalar Supination: Inversion Component.

Fig. 13-28. End of subtalar pronation: eversion component ROM, demonstrating proper alignment of goniometer at end of range.



First Metatarsophalangeal (MTP) Joint Flexion (Plantarflexion)

Fig. 13-29. Starting position for measurement of 1st MTP joint flexion. Bony landmarks for goniometer alignment (medial midline of 1st metatarsal, medial aspect of 1st MTP joint, medial midline of proximal phalanx) indicated by orange lines and dot.



Patient position:

Supine or seated with ankle in neutral position (Fig. 13-29).

Stabilization:

Over 1st metatarsal (Fig. 13-30).

Examiner action:

After instructing patient in motion desired, flex patient's 1st MTP joint through available ROM. Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-30).



Fig. 13-30. End of 1st MTP joint flexion ROM, showing proper hand placement for stabilizing 1st metatarsal and flexing MTP joint. Bony landmarks for goniometer alignment (medial midline of 1st metatarsal, medial aspect of 1st MTP joint, medial midline of proximal phalanx) indicated by orange lines and dot.

Fig. 13-31. Starting position for measurement of 1st MTP joint flexion, demonstrating proper initial alignment of goniometer.



Goniometer alignment: Palpate following bony landmarks (shown in Fig. 13-29) and align goniometer accordingly (Fig. 13-31).

Stationary arm: Medial midline of 1st metatarsal.

Axis: Medial aspect of 1st MTP joint.

Moving arm: Medial midline of proximal phalanx of great toe.
Read scale of goniometer.

Patient/Examiner action: Perform passive, or have patient perform active, MTP flexion (Fig. 13-32).

Confirmation of alignment: Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-32).

Documentation: Record patient's ROM.

Note: Alternative alignment is with goniometer positioned over dorsum of the joint, similar to MTP flexion of lateral four toes (see Metatarsophalangeal [MTP] or Interphalangeal [PIP, DIP, IP] Flexion).

Fig. 13-32. End of 1st MTP joint flexion ROM, demonstrating proper alignment of goniometer at end of range.



First Metatarsophalangeal (MTP) Joint Extension (Dorsiflexion)

Fig. 13-33. Starting position for measurement of 1st MTP joint extension. Bony landmarks for goniometer alignment (medial midline of 1st metatarsal, medial aspect of 1st MTP joint, medial midline of proximal phalanx) indicated by orange lines and dot.



Patient position:

Supine or seated, with ankle in neutral position (Fig. 13-33).

Stabilization:

Over 1st metatarsal (Fig. 13-34).

Examiner action:

After instructing patient in motion desired, extend patient's 1st MTP joint through available ROM. Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-34).



Fig. 13-34. End of 1st MTP joint extension ROM, showing proper hand placement for stabilizing 1st metatarsal and extending MTP joint. Bony landmarks for goniometer alignment (medial midline of 1st metatarsal, medial aspect of 1st MTP joint, medial midline of proximal phalanx) indicated by orange lines and dot.

Fig. 13-35. Starting position for measurement of 1st MTP joint extension, demonstrating proper initial alignment of goniometer.



- Goniometer alignment:** Palpate following bony landmarks (shown in Fig. 13-33) and align goniometer accordingly (Fig. 13-35).
- Stationary arm:** Medial midline of 1st metatarsal.
- Axis:** Medial aspect of 1st MTP joint.
- Moving arm:** Medial midline of proximal phalanx of great toe.
- Read scale of goniometer.
- Patient/Examiner action:** Perform passive, or have patient perform active, MTP extension (Fig. 13-36).
- Confirmation of alignment:** Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-36).
- Documentation:** Record patient's ROM.
- Note:** Alternative alignment is with goniometer positioned over dorsum of the joint, similar to MTP flexion of lateral four toes (see Metatarsophalangeal [MTP] or Interphalangeal [PIP, DIP, IP] Flexion).

Fig. 13-36. End of 1st MTP joint extension ROM, demonstrating proper alignment of goniometer at end of range.



First Metatarsophalangeal (MTP) Joint Abduction

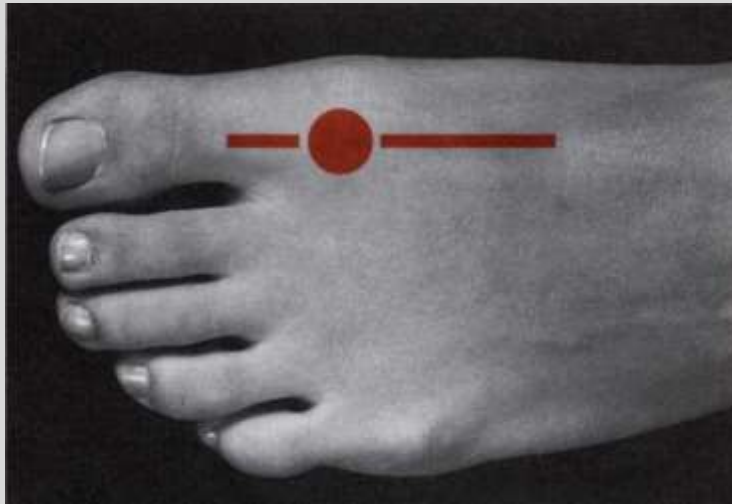


Fig. 13-37. Starting position for measurement of 1st MTP joint abduction. Bony landmarks for goniometer alignment (dorsal midline of 1st metatarsal, dorsal aspect of 1st MTP joint, dorsal midline of proximal phalanx) indicated by orange lines and dot.

Patient position:

Supine or seated, with ankle in neutral position (Fig. 13-37).

Stabilization:

Over 1st metatarsal (Fig. 13-38).

Examiner action:

After instructing patient in motion desired, abduct patient's 1st MTP joint through available ROM. Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-38).

Fig. 13-38. End of 1st MTP joint abduction ROM, showing proper hand placement for stabilizing 1st metatarsal and abducting MTP joint. Bony landmarks for goniometer alignment (dorsal midline of 1st metatarsal, dorsal aspect of 1st MTP joint, dorsal midline of proximal phalanx) indicated by orange lines and dot.

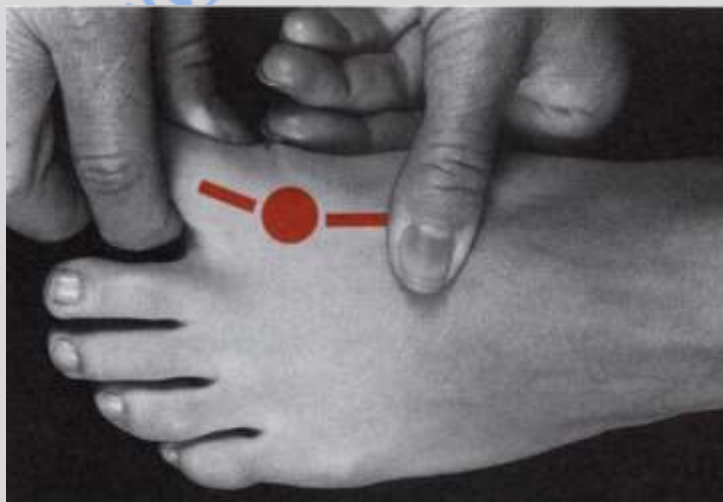
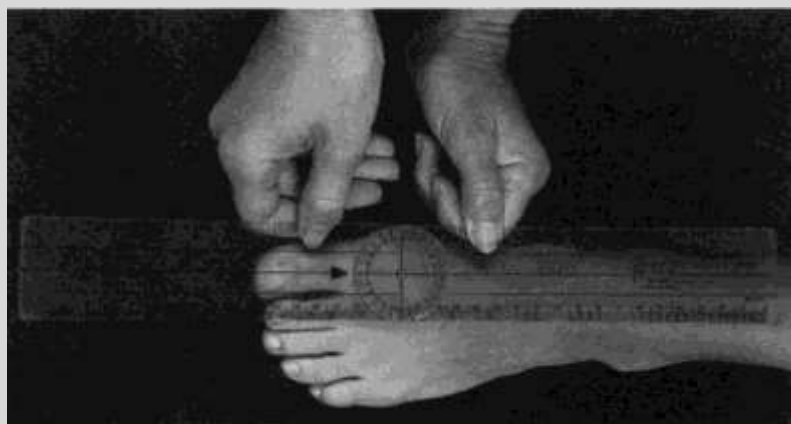


Fig. 13-39. Starting position for measurement of 1st MTP joint abduction, demonstrating proper initial alignment of goniometer.



Goniometer alignment:

Palpate following bony landmarks (shown in Fig. 13-37) and align goniometer accordingly (Fig. 13-39).

Stationary arm:

Dorsal midline of 1st metatarsal.

Axis:

Dorsal midline of 1st MTP joint.

Moving arm:

Dorsal midline of proximal phalanx of great toe.

Read scale of goniometer.

Patient/Examiner action:

Perform passive MTP abduction (Fig. 13-40; see Note).

Confirmation of alignment:

Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-40).

Documentation:

Record patient's ROM.

Note:

Active abduction of the 1st MTP joint may be difficult or impossible for many individuals.

Fig. 13-40. End of 1st MTP joint abduction ROM, demonstrating proper alignment of goniometer at end of range.



First Metatarsophalangeal (MTP) Joint Adduction

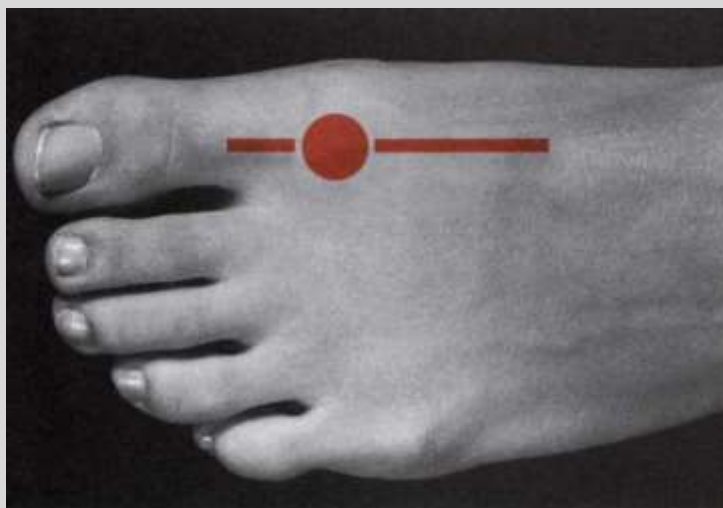


Fig. 13-41. Starting position for measurement of 1st MTP joint adduction. Bony landmarks for goniometer alignment (dorsal midline of 1st metatarsal, dorsal aspect of 1st MTP joint, dorsal midline of proximal phalanx) indicated by orange lines and dot.

Patient position:

Supine or seated, with ankle in neutral position (Fig. 13-41).

Stabilization:

Over 1st metatarsal (Fig. 13-42).

Examiner action:

After instructing patient in motion desired, adduct patient's 1st MTP joint through available ROM. Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-42).

Fig. 13-42. End of 1st MTP joint adduction ROM, showing proper hand placement for stabilizing 1st metatarsal and adducting MTP joint. Bony landmarks for goniometer alignment (dorsal midline of 1st metatarsal, dorsal aspect of 1st MTP joint, dorsal midline of proximal phalanx) indicated by orange lines and dot.

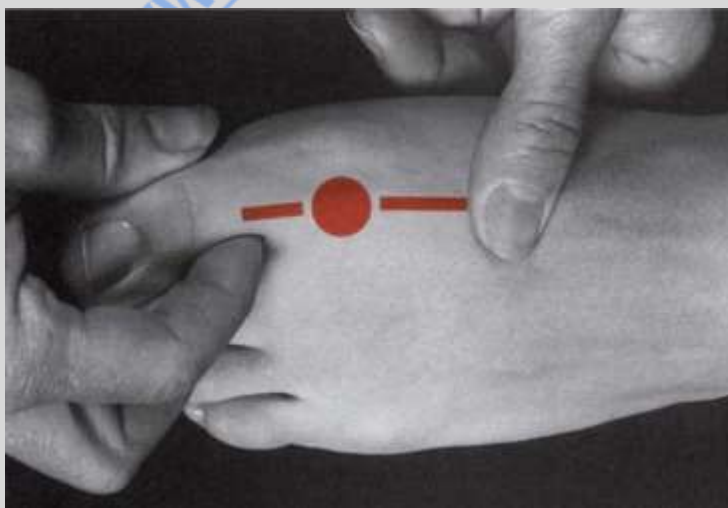
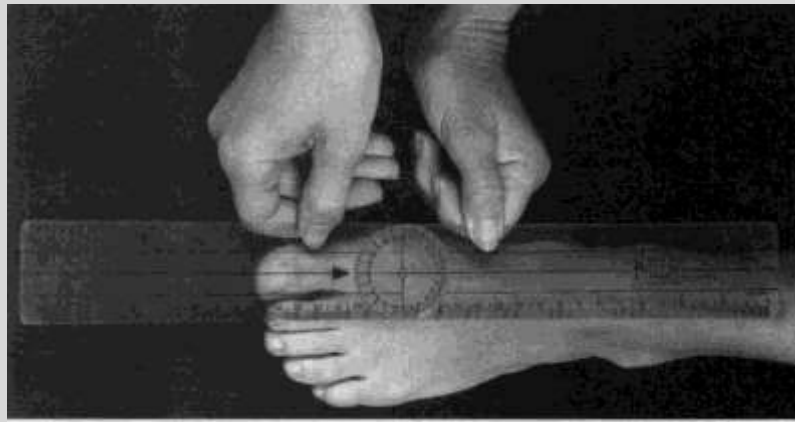


Fig. 13-43. Starting position for measurement of 1st MTP joint adduction, demonstrating proper initial alignment of goniometer.



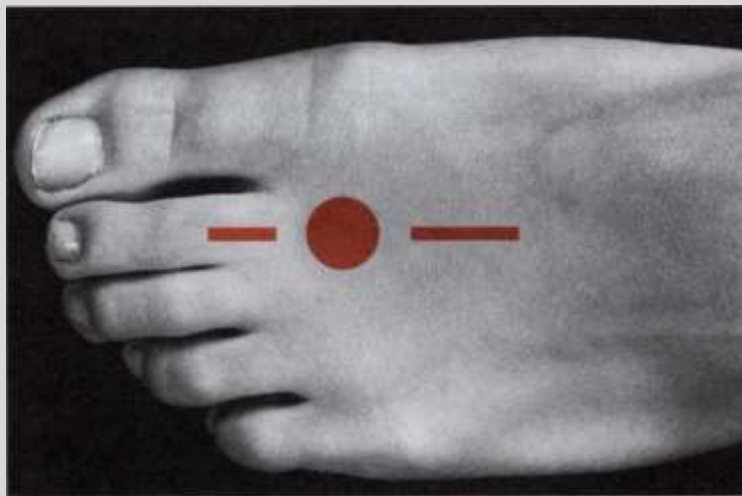
- Goniometer alignment:** Palpate following bony landmarks (shown in Fig. 13-41) and align goniometer accordingly (Fig. 13-43).
- Stationary arm:** Dorsal midline of 1st metatarsal.
- Axis:** Dorsal midline of 1st MTP joint.
- Moving arm:** Dorsal midline of proximal phalanx of great toe.
Read scale of goniometer.
- Patient/Examiner action:** Perform passive MTP adduction (Fig. 13-44; see Note).
- Confirmation of alignment:** Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-44).
- Documentation:** Record patient's ROM.
- Note:** Active adduction of the 1st MTP joint may be difficult or impossible for many individuals.

Fig. 13-44. End of 1st MTP joint adduction ROM, demonstrating proper alignment of goniometer at end of range.



Metatarsophalangeal (MTP) or Interphalangeal (PIP, DIP, IP) Flexion

Fig. 13-45. Starting position for measurement of MTP joint flexion. Bony landmarks for goniometer alignment (dorsal midline of metatarsal, dorsal aspect of MTP joint, dorsal midline of proximal phalanx) indicated by orange lines and dot.



Measurement of 2nd MTP Joint Shown

Patient position:

Supine or seated, with ankle in neutral position (Fig. 13-45).

Stabilization:

Over more proximal bone of joint to be measured (in this case, stabilization of metatarsals is shown) (Fig. 13-46).

Examiner action:

After instructing patient in motion desired, flex joint to be measured through available ROM. Return toe to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-46).

Fig. 13-46. End of MTP joint flexion ROM, showing proper hand placement for stabilizing metatarsal and flexing MTP joint. Bony landmarks for goniometer alignment (dorsal midline of metatarsal, dorsal aspect of MTP joint) indicated by orange line and dot.

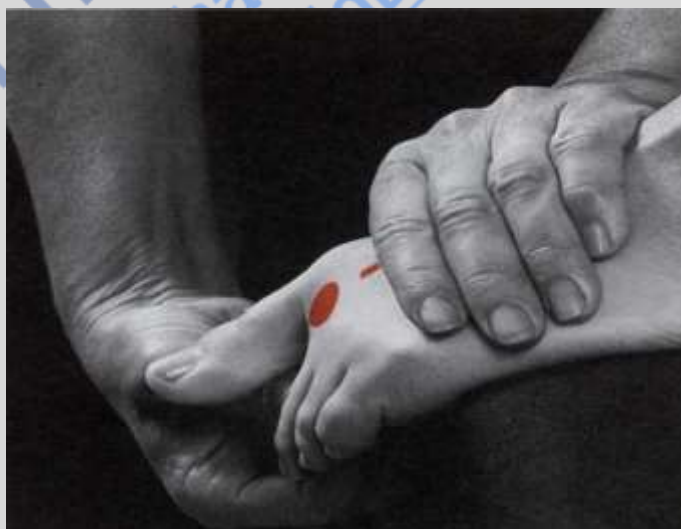


Fig. 13-47. Starting position for measurement of MTP joint flexion, demonstrating proper initial alignment of goniometer.



Goniometer alignment:

Stationary arm:

Palpate following bony landmarks (shown in Fig. 13-45) and align goniometer accordingly (Fig. 13-47).

Axis:

Dorsal midline of more proximal bone of joint to be measured (in this case, the metatarsal).

Moving arm:

Dorsal midline of joint to be measured (in this case, the MTP joint).

Dorsal midline of more distal bone of joint to be measured (in this case, the proximal phalanx).

Read scale of goniometer.

Patient/Examiner action:

Perform passive, or have patient perform active, flexion of joint to be measured (Fig. 13-48).

Confirmation of alignment:

Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-48).

Documentation:

Record patient's ROM.

Alternative patient position:

Sidelying; goniometer alignment remains same.

Note:

This technique may be used to measure flexion of the MTP, DIP, or PIP joints of the lateral four toes, or flexion of the MTP or IP joint of the great toe. The figures shown here depict the measurement of MTP flexion of the 2nd toe.

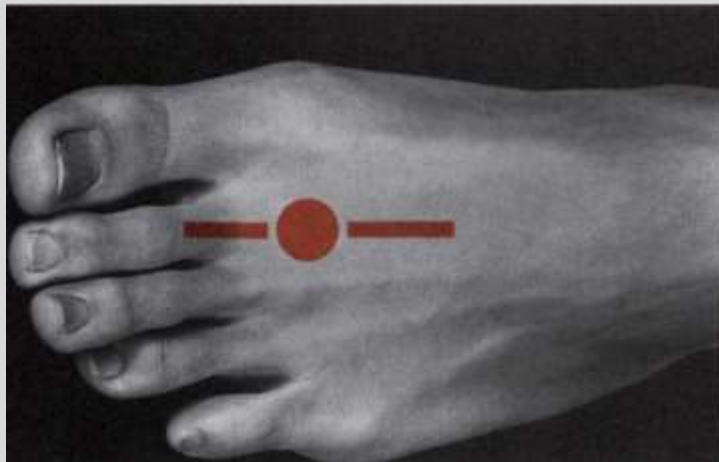
Fig. 13-48. End of MTP joint flexion ROM, demonstrating proper alignment of goniometer at end of range.



Metatarsophalangeal (MTP) or Interphalangeal (PIP,DIP, IP)

Extension

Fig. 13-49. Starting position for measurement of MTP joint extension. Bony landmarks for goniometer alignment (dorsal midline of metatarsal, dorsal aspect of MTP joint, dorsal midline of proximal phalanx) indicated by orange lines and dot.



Measurement of 2nd MTP Joint Shown

Patient position:

Supine or seated, with ankle in neutral position (Fig. 13-49).

Stabilization:

Over more proximal bone of joint to be measured (in this case, stabilization of metatarsals is shown) (Fig. 13-50).

Examiner action:

After instructing patient in motion desired, extend joint to be measured through available ROM. Return limb to starting position. Performing passive movement provides an estimate of the ROM and demonstrates to patient exact motion desired (see Fig. 13-50).



Fig. 13-50. End of MTP joint extension ROM, showing proper hand placement for stabilizing metatarsal and extending MTP joint. Bony landmarks for goniometer alignment (dorsal aspect of MTP joint, dorsal midline of proximal phalanx) indicated by orange line and dot.

Fig. 13-51. Starting position for measurement of MTP joint extension, demonstrating proper initial alignment of goniometer.



Goniometer alignment:

Stationary arm:

Palpate following bony landmarks (shown in Fig. 13-49) and align goniometer accordingly (Fig. 13-51).

Axis:

Dorsal midline of more proximal bone of joint to be measured (in this case, the metatarsal).

Moving arm:

Dorsal midline of joint to be measured (in this case, MTP joint).

Dorsal midline of more distal bone of joint to be measured (in this case, the proximal phalanx).

Read scale of goniometer.

Patient/Examiner action:

Perform passive, or have patient perform active, extension of joint to be measured (Fig. 13-52).

Confirmation of alignment:

Repalpate landmarks and confirm proper goniometric alignment at end of ROM, correcting alignment as necessary. Read scale of goniometer (Fig. 13-52).

Documentation:

Record patient's ROM.

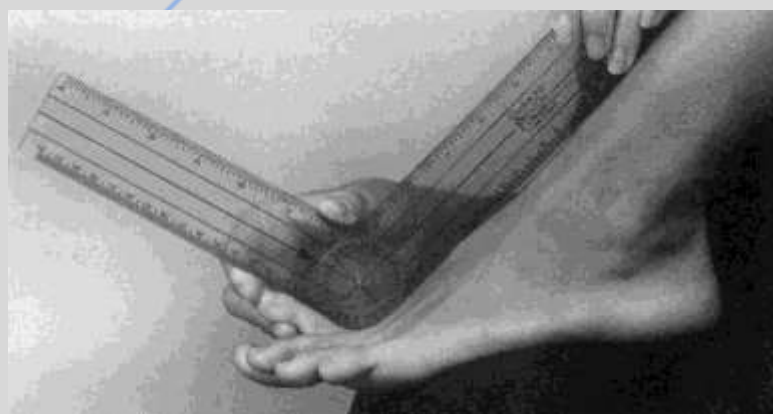
Alternative patient position:

Sidelying; goniometer alignment remains same.

Note:

This technique may be used to measure extension of the MTP, DIP, or PIP joints of the lateral four toes, or extension of the MTP or IP joint of the great toe. The figures shown here depict the measurement of MTP extension of the 2nd toe.

Fig. 13-52. End of MTP joint extension ROM, demonstrating proper alignment of goniometer at end of range.



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